PUBLIC DOCUMENT . . . . . No. 55.

# ANNUAL REPORT

OF THE

# INSPECTOR

OF

# Gas Meters and Illuminating Gas.

JANUARY, 1895.

BOSTON:
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18 POST OFFICE SQUARE.
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Office of Gas Inspection, 32 Hawley Street,
Boston, Jan. 28, 1895.

*To the Honorable Senate and the House of Representatives.*

The Inspector of Gas Meters and of Illuminating Gas submits the following report: —

During the year ending Dec. 31, 1894, 25,021 meters were inspected. This is a much larger number than usual, and is due to the large number taken by the Brookline Gas Light Company. There were 24,417 new or repaired meters presented for inspection by the manufacturers or gas companies, as the law requires all new or repaired meters to be inspected and sealed by the State inspector before being used to measure gas to consumers. A few of these, being found to register incorrectly, were returned for adjustment and then retested.

There were 604 meters reinspected, which, being in use, were suspected of being incorrect by either the consumer or gas company. The law provides in this case that either party may ask for an official reinspection. Of these meters 327 were correct within the legal limits of 2 per cent. fast or slow, and were resealed. The fast meters numbered 217, the average error being 4.70 per cent.; there were 55 slow meters, the average error being 8.56 per cent.; 4 meters would not register and 1 would not pass gas. The average error of the 599 meters was .99 per cent. fast. Of the 217 fast meters, 36 were more than 5 per cent. fast, 3 more than 10 per cent. and 1 was 36 per cent. fast. Of the 55 slow meters, 19 were more than 5 per cent. slow, 3 more than 10, 3 were 16, 4 were 25, 1 was 26, and the slowest was 32 per cent. slow.

During the investigation into the methods of the gas companies operating in and around Boston, made by the Board of Gas and Electric Light Commissioners in March, in response to an order of the General Court, a number of meters were tested at the Board's request. These meters were selected from lists, furnished by the Board, of consumers whose bills had increased in the second period, that of reduced price, over those of the corresponding period the previous year. The following table gives the results: —

| COMPANY. | Number of Meters tested. | Average Error, Per Cent. Fast. |
|---|---|---|
| Boston, | 43 | 1.51 |
| South Boston, | 27 | 0.80 |
| Dorchester, | 25 | 0.66 |
| Roxbury, | 8 | 0.06 |
| Chelsea, | 20 | 2.65 |
| East Boston, | 22 | 3.93 |
| Brookline, | 5 | 1.00 |

Average of the 150 meters, 1.65 per cent. fast. Average length of time since last inspection (meter either new or repaired), 6.69 years. Only four-tenths of one per cent. of the meters in use by these companies were tested, and these, too, were meters of consumers whose bills showed an increase when a decrease would have been expected. These are severe conditions, and fast meters would be more liable to be found than if an equal number had been taken of consumers whose bills had decreased; the average error, 1.65 per cent. fast, is within the two per cent. limit allowed by law. The companies whose meters showed greatest variations have generally had high ammonias, as shown by the following table, the results being grains per one hundred feet of gas, the maximum allowed by law being ten grains, and the average being that of the larger companies.

| | 1886. | 1887. | 1888. | 1889. | 1890. | 1891. | 1892. | 1893. | 1894. |
|---|---|---|---|---|---|---|---|---|---|
| Average, State, . | 2.84 | 3.19 | 3.65 | 2.98 | 3.51 | 3.88 | 3.08 | 2.59 | 1.91 |
| East Boston, . . | 5.76 | 6.70 | 6.39 | 4.71 | 7.14 | 7.72 | 11.26 | 7.86 | 2.37 |
| Chelsea, . . . | 2.21 | 2.34 | 3.50 | 1.20 | 6.87 | 13.39 | 7.46 | 5.87 | 3.49 |
| South Boston, . . | 6.90 | 5.82 | 9.59 | 8.23 | 8.72 | 5.78 | 4.46 | 4.17 | 3.05 |

These companies are taking the ammonia out now, as shown by the late tests. South Boston furnishes water gas, which contains little if any ammonia, and East Boston and Chelsea have put in suitable apparatus to remove it.

Five meter provers have been standardized and two old ones retested the past year.

The law provides that the gas of every company supplying illuminating gas to more than fifty consumers shall be tested at least twice a year, and that an additional inspection shall be made for every six million feet of gas supplied, but the inspections must not be made oftener than once a week. No notice is given the companies of intended inspections, which are made at irregular intervals, so that no preparation can be made, if the companies were so inclined. The majority of inspections is made during the winter months, so as to follow the consumption to an extent. The minimum candle-power allowed is sixteen; the standard English candles, corrected to a rate of burning of one hundred and twenty grains per hour, being used, and the gas burned at a rate of five feet per hour. The coal gases and mixed coal and water gases are tested with the standard Sugg's "London Argand" burner, size "D" generally being used; the higher candle-power water gases are tested with the Sugg's "table top" open burner, six feet size. The pure petroleum gases are burned through small lava-tip open burners, of from three-quarters of a foot to two feet per hour capacity, the results being calculated to an hourly rate of five feet; for the petroleum gases mixed with air both Argand and lava-tip burners are used, depending on the amount of air in the mixture. Twenty grains total sulphur and ten grains of ammonia per one hundred cubic feet of gas are the maxima allowed of these impurities; no sulphuretted hydrogen is

allowed. The following tables give the averages of candle-power, sulphur and ammonia found, and number of inspections made at each place.

The results of the tests made during the year by the assistant inspector and myself were furnished from time to time to the Board of Gas and Electric Light Commissioners at its request.

*Larger Companies.*

| Number of Inspections made. | NAME OF PLACE OR COMPANY. | CANDLE-POWER. | | | GRAINS PER ONE HUNDRED FEET OF GAS OF— | |
|---|---|---|---|---|---|---|
| | | Average. | Highest. | Lowest. | Sulphur. | Ammonia. |
| 52 | Boston, | 24.70 | 26.3 | 22.1 | 7.19 | 1.— |
| 16 | Brookline, | 26.63 | 29.0 | 22.8 | 6.86 | 1.— |
| 25 | Cambridge, | 17.96 | 19.0 | 16.2 | 12.89 | 2.51 |
| 16 | Charlestown, | 18.69 | 19.9 | 16.2 | 11.21 | 1.— |
| 7 | Chelsea, | 17.71 | 18.8 | 16.4 | 7.34 | 3.49 |
| 16 | Dorchester, | 24.85 | 28.5 | 23.1 | 7.69 | 1.— |
| 9 | East Boston, | 17.94 | 19.0 | 16.6 | 9.34 | 2.37 |
| 11 | Fall River, | 24.34 | 25.9 | 21.9 | 8.96 | 1.— |
| 11 | Haverhill, | 26.05 | 27.2 | 22.4 | 5.78 | 1.— |
| 11 | Holyoke, | 17.94 | 19.5 | 15.6 | 13.65 | 4.25 |
| 9 | Jamaica Plain, | 18.37 | 20.1 | 16.7 | 10.36 | 1.— |
| 14 | Lawrence, | 19.86 | 21.3 | 19.4 | 9.79 | 1.— |
| 46 | Lowell, | 19.54 | 22.2 | 18.1 | 8.15 | 2.22 |
| 17 | Lynn, | 19.98 | 22.4 | 18.5 | 12.06 | 1.01 |
| 9 | Malden, | 18.26 | 19.3 | 17.6 | 12.34 | 2.92 |
| 9 | New Bedford, | 20.04 | 21.6 | 18.9 | 7.16 | 1.— |
| 12 | Newton, | 17.59 | 18.1 | 16.9 | 13.07 | 1.— |
| 32 | Roxbury, | 24.11 | 25.4 | 21.7 | 7.80 | 1.— |
| 8 | Salem, | 18.62 | 19.6 | 17.1 | 11.10 | 1.21 |
| 15 | South Boston, | 23.18 | 27.1 | 16.9 | 10.31 | 3.05 |
| 17 | Springfield, | 18.38 | 19.5 | 17.2 | 12.00 | 4.65 |
| 9 | Taunton, | 17.66 | 18.9 | 16.9 | 7.93 | 5.50 |
| 7 | Waltham, | 19.16 | 22.8 | 16.8 | 4.54 | 3.13 |
| 26 | Worcester, | 19.61 | 21.2 | 16.9 | 10.57 | 1.— |
| | Average, | 20.47 | – | – | 9.51 | 1.91 |

*Smaller Companies.*

| Number of Inspections made. | NAME OF PLACE OR COMPANY. | Candle-power. | GRAINS PER ONE HUNDRED FEET OF GAS OF— | |
|---|---|---|---|---|
| | | | Sulphur. | Ammonia. |
| 3 | Adams, | 17.73 | 8.53 | 1.— |
| 3 | Amesbury, | 23.73 | 8.95 | 1.— |
| 3 | Arlington, | 17.17 | 8.50 | 1.— |
| 2 | Athol, | 19.10 | 8.60 | 1.— |
| 3 | Attleborough, | 17.47 | 8.83 | 1.43 |
| 3 | Beverly, | 18.77 | 10.33 | 7.03 |
| 5 | Brockton, | 18.98 | 13.56 | 3.30 |
| 3 | Chicopee, | 20.10 | 5.73 | 1.— |
| 3 | Clinton, | 18.13 | 9.33 | 1.— |
| 2 | Danvers, | 17.55 | 10.80 | 1.— |
| 3 | Dedham, | 19.17 | 13.73 | 1.— |
| 3 | Easthampton, | 22.00 | 10.35 | 9.23 |
| 5 | Fitchburg, | 17.60 | 12.02 | 1.— |
| 5 | Gloucester, | 17.58 | 15.66 | 1.— |
| 3 | Greenfield, | 16.93 | 9.00 | 13.— |
| 4 | Manufacturers' (Fall River), | 18.37 | 6.93 | 2.08 |
| 2 | Marblehead, | 17.60 | 17.90 | 1.— |
| 3 | Marlborough, | 17.47 | 10.73 | 6.17 |
| 3 | Milford, | 18.57 | 8.50 | 3.96 |
| 3 | Nantucket, | 18.04 | 6.23 | 1.— |
| 2 | Natick, | 17.55 | 8.40 | 1.— |
| 3 | Newburyport, | 17.10 | 11.20 | 1.— |
| 5 | North Adams, | 17.84 | 8.12 | 1.76 |
| 4 | North Attleborough, | 17.37 | 4.12 | 3.52 |
| 4 | Northampton, | 18.12 | 9.10 | 4.65 |
| 2 | Norwood, | 18.40 | 7.20 | 13.55 |
| 4 | Pittsfield, | 23.20 | 8.42 | 1.— |
| 3 | Plymouth, | 17.40 | 9.87 | 9.57 |
| 3 | Quincy, | 17.60 | 13.13 | 3.07 |
| 3 | Spencer, | 20.93 | 6.67 | 1.— |
| 3 | Wakefield, | 16.63 | 11.90 | 1.70 |
| 3 | Ware, | 18.30 | 6.43 | 6.40 |
| 2 | Webster, | 18.35 | 4.70 | 1.— |
| 3 | Westfield, | 18.43 | 4.27 | 1.— |
| 3 | Woburn, | 18.03 | 12.93 | 1.— |
| | Average, | 18.49 | 9.45 | 3.02 |

*Companies Making Gas from Petroleum.*

| Number of Inspections made. | NAME OF PLACE OR COMPANY. | Candle-power. |
|---|---|---|
| 2 | Amherst, | 34.10 |
| 2 | Chicopee Falls, | 22.80 |
| 2 | Gardner, | 36.50 |
| 2 | Ipswich, | 24.25 |
| 2 | Leominster, | 29.00 |
| 2 | Lexington, | 28.40 |
| 2 | Middleborough, | 26.00 |
| 2 | Southbridge, | 24.90 |
| 2 | Stoughton, | 42.55 |
| 2 | Williamstown, | 46.30 |
| | Average, | 31.48 |

Leaving out the oil-gas companies, the averages of the State were: candle-power, 19.31, an increase of .39; sulphur, 9.47; and ammonia, 2.57. The larger companies average increased 1.01 candles over last year, while the smaller companies decreased .05 candles. The sulphur increased in both large and small companies, while the ammonia decreased in large and increased in smaller companies. The thirty-nine coal gases averaged 17.98, an increase of .12 candles; the eleven water gases averaged 23.64; and the nine mixed coal and water gases averaged 19.63.

At Gloucester, Plymouth, Manufacturers' of Fall River, Westfield and Fitchburg the tests have been made at the works, as being the most available places. The company at Fitchburg has just put in a photometer at its up-town office, which will be used in the future. It is expected that Gloucester and North Adams will put in photometers this year. The Brookline testing station has been moved into Boston; the Dorchester station to the disused Dorchester

works, on account of the difficulty of heating the room formerly employed.

The following violations of the law have occurred during the year at the places named: —

Deficient candle-power: —

| | |
|---|---|
| Holyoke, December 28, | 15.6 candle-power. |
| Marlborough, October 16, | 15.8 " " |
| Wakefield, September 29, | 15.9 " " |

Excesses of sulphur: —

| | |
|---|---|
| Cambridge, November 9, | 20.8 grains sulphur. |
| Charlestown, October 13, | 20.6 " " |
| Gloucester, September 28, | 23.5 " " |
| Holyoke, August 8, | 21.1 " " |
| Marblehead, February 10, | 20.6 " " |

Excesses of ammonia: —

| | | | |
|---|---|---|---|
| Easthampton, March 14, | 12.7 | Norwood, June 27, | 26.3 |
| Easthampton, May 11, | 11.9 | Plymouth, May 3, | 25.0 |
| Greenfield, September 26, | 31.3 | South Boston, March 13, | 11.1 |
| Holyoke, March 2, | 20.0 | Springfield, April 25, | 11.6 |
| Holyoke, October 26, | 10.5 | Springfield, May 23, | 11.5 |
| Marlborough, October 16, | 14.5 | Taunton, December 21, | 22.2 |

These results of sulphur and ammonia are given in grains per one hundred feet of gas. The ammonia at Easthampton and Springfield was found in excess on consecutive inspections. At the following places sulphuretted hydrogen was detected on the dates given: —

| | |
|---|---|
| Amesbury, February 7. | Gardner, November 16. |
| Amesbury, May 18. | Marlborough, April 25. |
| Amesbury, November 1. | Spencer, May 5. |
| Boston, December 6. | Spencer, October 4. |
| Chicopee Falls, November 15. | |

At Amesbury the tests were consecutive, and a fine of one hundred dollars became due the town. At Spencer the last test of 1893 showed the presence of sulphuretted hydrogen, and these two tests, being consecutive, made the required three consecutive tests for a fine. It is to be noticed that although vigorous measures were adopted at Spencer immediately after the test of May 5, and the gas was properly purified, yet enough sulphuretted hydrogen remained in the

water of the holder tank to foul the gas. It has frequently happened in the case of sulphuretted hydrogen and ammonia, which are readily dissolved in water, that clean gas has been fouled in the holder and pipes.

The following eudiometric analyses have been made during the year. The first two are water gas, the third mixed water and coal, the next four coal gas. Waltham introduced a new process in September, and the eighth sample is some of the new gas; the high nitrogen has since been reduced by adding coal gas.

| PLACE. | Candle-power. | Illuminants. | Marsh Gas. | Hydrogen. | Carbonic Oxide. | Nitrogen. | Oxygen. | Carbonic Acid. |
|---|---|---|---|---|---|---|---|---|
| Boston, . . . | 24.9 | 16.59 | 19.78 | 32.07 | 26.10 | 2.42 | - | 3.04 |
| Brookline, . . . | 26.4 | 15.92 | 26.09 | 26.73 | 26.15 | 2.04 | - | 3.07 |
| Lynn, . . . . | 19.4 | 9.39 | 28.74 | 42.56 | 15.74 | 1.48 | - | 2.09 |
| North Adams, . . | 18.7 | 5.87 | 39.14 | 46.73 | 6.99 | 1.27 | - | - |
| Taunton, . . . | 17.4 | 4.82 | 35.86 | 52.00 | 5.80 | 1.44 | - | 0.08 |
| Newton, . . . | 17.2 | 5.14 | 34.55 | 48.96 | 7.26 | 3.14 | - | 1.00 |
| Newton, . . . | 17.3 | 5.18 | 35.47 | 48.73 | 6.25 | 3.00 | 0.13 | 1.24 |
| Waltham, . . . | 21.7 | 19.17 | 34.52 | 10.70 | 0.82 | 34.22 | 0.15 | 0.42 |

The question of temperature of the photometer rooms having arisen during the year, some experiments were made to determine whether the temperature were an important factor, and, if so, to what extent. The method was to burn the gas under the same conditions, as nearly as possible, as in photometrical tests, with an air supply the temperature of which could be easily changed. To the perforated bottom of a large lantern was attached an air chamber, supplied with thermometers and a window for observations. The gas burner in the lantern was put as near the bottom as possible, so that the temperature of the air did not change from the thermometers to the immediate vicinity of the burner. This was shown to be the case by experiment. Air was supplied to this chamber through a large pipe, one section of which was provided with tubes which could be heated by gas in order to raise the temperature of the incoming air; suitable baffle plates ensured uniformity of temperature by thoroughly

mixing the air, and also prevented an unsteady supply to the burner. The lantern was lined with black velvet, to prevent reflections. The candle-power was taken with the portable photometer, using the Edgerton standard, frequently standardized against candles. Care was used to keep the room at 60° F. during the series of tests. The first table gives the results obtained with a water gas burned through the open testing burner, Sugg's "table top," the second table the results using an Argand with coal gas, the results in each case being the average of a number of determinations : —

*Open Burner.*

| Temperature (Degrees F.). | Observed Candle-power. | Corrected Candle-power. | Increase or Decrease. | Percentage Increase or Decrease. |
|---|---|---|---|---|
| 30 | 8.46 | 19.27 | 2.92 Dec. | 13.2 |
| 35 | 8.82 | 20.09 | 2.10 | 9.5 |
| 41 | 9.02 | 20.56 | 1.63 | 7.3 |
| 50 | 9.46 | 21.55 | 0.64 | 2.9 |
| 56 | 9.70 | 22.10 | 0.09 | 0.4 |
| 60–66 | 9.74 | 22.19 | – | – |
| 72 | 9.91 | 22.57 | 0.38 Inc. | 1.7 |
| 81 | 10.10 | 23.01 | 0.82 | 3.7 |
| 89 | 10.26 | 23.36 | 1.17 | 5.3 |
| 100 | 10.84 | 24.69 | 2.50 | 11.3 |

*London Argand Burner.*

| | | | | |
|---|---|---|---|---|
| 35 | 8.84 | 16.26 | 0.17 Dec. | 1.0 |
| 41 | 8.85 | 16.28 | 0.15 | 0.9 |
| 47 | 8.87 | 16.32 | 0.09 | 0.5 |
| 56 | 8.92 | 16.41 | 0.02 | 0.1 |
| 61–65 | 8.93 | 16.43 | – | – |
| 70 | 8.94 | 16.45 | 0.02 Inc. | 0.1 |
| 81 | 8.97 | 16.50 | 0.07 | 0.4 |
| 87 | 9.12 | 16.78 | 0.35 | 2.1 |
| 95 | 9.52 | 17.51 | 1.08 | 6.6 |
| 100 | 9.76 | 17.95 | 1.52 | 9.3 |

These results show that with the open burner and high candle-power gas the temperature has a decided effect, due to the gas having an unlimited air supply, the temperature of which can easily influence the burning gas by lowering or raising the flame temperature; but with the Argand burner the construction of the burner in limiting the supply of air and heating it somewhat before combustion would tend to counteract the effect of cold air, as was found. The heated air, by adding to the flame temperature, increased the candle-power noticeably. It is desirable to keep the photometer rooms between 60 and 70° F., as colder rooms will detract from the candle-power, while warmer ones will increase it.

The assistant inspector, Mr. L. S. James, is assisting in performing the duties of the office.

The above is respectfully submitted.

CHARLES D. JENKINS,
*Inspector of Gas and Gas Meters.*